FARMSTEAD WATER SUPPLY

Prepared in the
Office of the District Engineer

FARM SECURITY ADMINISTRATION

REGION IX SAN FRANCISCO

OCTOBER, 1942

Material in this handbook has been compiled from Soil Conservation handbooks, United States Forest Service bulletins, and various other sources.

Reference to any particular make of equipment shall not be construed to mean that such is recommended over competitive makes of equal quality, as such references are only intended as a measure of quality.

INTRODUCTION

The purpose of this handbook is to make available to field men standards governing the development and operation of small water supplies.

WATER REQUIREMENTS

Table I - Persons & Livestock

	Average Gallons per day
For each member of a family for all uses	30
Schools, per person	7
For each horse, mule, or head of cattle	15
For each dairy cow	30
For each hog or sheep	3
For each 100 chickens	3
For each 100 turkeys	7

Table II - Plumbing Fixtures

	Gallons per minute
Bath tub (about 30 gallons)	5-10
Lavatory ($1\frac{1}{2}$ gallons)	3-5
Tank closets (flushing 4-6 gallons)	3-5
Shower Bath (about 30 gallons)	3-5
Laundry tub	5-10
Sink (each faucet 7-15 gallons per day)	3-10
Lawn sprinkling $\frac{1}{2}$" hose	2-4
Lawn sprinkling 3/4" hose	4-8
To sprinkle 100 square feet of lawn ($\frac{1}{4}$" of water)	16 gallons
To soak 100 square feet of lawn (1" of water)	65 gallons

SELECTION OF SUPPLY

Quality, quantity and daily requirement shall be considered in selecting a supply. Before undertaking a development a sample if possible, should be taken of the water, and a test made to determine its potability and possible contamination. Such tests will usually be made by State or County Health Authorities. After a development has been put into use, periodic tests should be made of the water supply.

SPRINGS

Spring water should not be considered as satisfactory, just because it is cool, clean, and pleasant to taste. A survey should be made of all existing or proposed buildings, sewage disposal works, drainage, and any other conditions which may affect the spring supply.

Contamination of a spring may occur as follows:

1. Surface water draining into spring.
2. Livestock drinking from spring.
3. Seepage from contaminated water, which may reach the spring from a far removed source through fissures.

DEVELOPMENT AND CONSTRUCTION

To develop a spring it is necessary to clean out the opening; locate the true water outcrop; and to provide a means for collecting the water and protecting the supply from pollution.

Improper development may render a spring useless, or less useful. The flow of a spring is dependent upon the head of water; and any attempt to gain elevation for a supply may result not only in a decrease in yield, but may cause the spring to emerge elsewhere.

In building an encasement the spring shall be permitted to flow into and out of the encasement unrestricted. Outflow pipe should not be less than one inch.

Encasement shall be made from an impervious material. Brick and stone wall construction should be 8 to 12 inches in thickness and completely plastered. Concrete walls when used should be 6 inches in thickness. A 1:2:4 concrete mix is recommended, and requires $5\frac{1}{2}$ sacks cement, 0.9 cu. yds. gravel and 0.5 cu.yds. sand for each cubic yard of concrete. Concrete shall be kept moist for 7 days.

[illegible]

Quality, quantity and daily requirement should be considered in selecting a supply. Before constructing a development a sample, if possible, should be taken of the water, and a test made to determine the potability and possible contaminations. Such tests will usually be made by State or County Health Authorities. After a development has been put into use, periodic tests should be made of the water supply.

SPRINGS

Spring water should not be considered as satisfactory, just because it is cool, clear, and pleasant to drink. A survey should be made of all existing or proposed buildings, sewage disposal works, drainage, and any other conditions which may affect the spring supply.

Contamination of a spring may occur as follows:

1. Surface water draining into springs.
2. Livestock drinking from springs.
3. Seepage from contaminated water, which may reach the spring from a far removed source through fissures.

[illegible] AND PROTECTION

To develop a spring it is necessary to clean out the original source thoroughly and to provide a means for collecting the water and protecting the supply from pollution.

Improper development may render a spring useless, or less useful. The flow of a spring is dependent upon the level of water and any attempt to gain elevation for a supply may result not only in a decrease in yield, but may cause the spring to seek a new outlet.

In building an encasement the spring should be permitted to flow into and out of the encasement unrestricted. Overflow pipe should not be less than one inch.

Encasement should be made from an impervious material. Brick and stone wall construction should be 8 or 12 inches in thickness and completely plastered. Concrete walls when used should be 6 inches in thickness. A 1:2:4 concrete mix is recommended, and requires 6 sacks cement, 0.9 cu. yds. gravel and 0.5 cu.yds. sand for each cubic yard of concrete. Concrete shall be kept moist for 7 days.

A water tight cover shall be constructed over encasement, preferably of concrete. Asphalt or mastic may be used for water seal.

Fencing may be desirable to protect encasement from livestock.

A drain pipe and valve is desirable for the purpose of draining encasement, when cleaning becomes necessary.

An overflow pipe shall also be installed. Outflow and overflow pipe shall be screened. See figure 1 for details.

SURFACE SUPPLIES

When a well or spring supply of water is not obtainable, a surface supply can be considered, but only as a last resort. Collection and storage will vary widely. The water will have to be chlorinated; and in some cases a further treatment consisting of sedimentation, coagulation and filtration may be necessary. Storage in cisterns are subject to pollution. However, there are times when it becomes necessary to construct cisterns. Figure 2 shows a satisfactory design.

Cisterns should be made of concrete, brick or masonry; never of metal. Filtering material should be kept clean by periodic and numerous checks, and a washing or changing of the filtering material. Filtering alone is not considered a safeguard against bacteria, so that chlorination is also recommended.

Before undertaking the construction and operation of a cistern consult the office of the District Engineer, San Francisco, California.

WELLS

Wells will probably be the most common type of water development. The first consideration is to obtain a pollution free supply. Pollution can come from the ground surface as well as through underground water passages. Shallow and dug wells are naturally most liable to pollution.

The second consideration is to obtain the water in the most economical manner. Overall economy is poor if too small or poor casing is used, which may reduce the life of the facility.

In locating a well, the following should be considered:

1. Relative elevation with respect to floods.
2. Direction of ground water flow.

3. Possible source of contamination, such as privies, cesspools, septic tanks, sewer lines, sink holes, abandoned wells, barns, industrial wastes, polluted streams, etc.
4. Well drilling information from local drillers, well owners, state Department of Health and State Geologist to aid in determining depths to, quality and quantity of water, formations and drilling costs.
5. Location of storage tank if used.

TYPES OF WELLS

(1) Dug and bored
(2) Driven
(3) Drilled

It is essential and shall be required that logs be kept of every well drilled, showing the various strata, their depth and thickness. Such logs prove invaluable for future well construction in the area. Driven or drilled wells are preferable to dug wells, because they are simpler to construct and to maintain free from contamination.

No well should be closer than 10 feet to any building or closer than 60 feet to any source of contamination.

Where only a small quantity of water is needed, and a safe supply can be found within 20 to 30 feet from ground surface, any type of well may prove satisfactory.

For depths up to 100', $1\frac{1}{2}$" to 3" open end driven wells have been used, depending upon formations encountered. Where greater depths are known to be necessary or where rock will be encountered, at least a 4" well should be planned.

Driven wells are either the "closed-end" or the "open-end" type.

The "closed end" type consists of a tube of wrought iron or steel pipe, closed and pointed at one end, and perforated back from the end. This tube is driven into the ground until it penetrates a water bearing stratum.

This well is adapted for use in soft ground or sand, and for depths not to exceed 50'. The upper end of the tube is connected to a pump and the well is ready for use except for developing by pumping to clean the well of sand.

A driven "closed end" type of well should not be less than 2" in diameter.

The "open end" type of well is used in harder ground, for larger sizes and for greater depths than the "closed-end" type. This well is sunk by removing the material from the interior, and at the same time driving the tubing. Materials are removed from the interior by means of a water jet. Water for jetting purposes should be of an approved quality. Where formations are known to be hard, or the well deep, a steel cutting shoe may be screwed on the end of the tubing.

With this type of well, the lower portion may be merely perforated where the water bearing stratum is coarse or gravelly. If sand is encountered, the holes may be covered with brass gauze, or the tube may be sunk, and a strainer inserted. If a strainer is inserted the tube shall be withdrawn nearly to the top of the strainer and a seal made just above where the strainer joins the lower part of the well casing. This is generally done with a lead packer.

Strainer should be so located that it will at all times be under water.

This type of well can be used up to sizes of 4" in diameter.

DRILLED WELLS

Drilled wells are used where depths will be in excess of 75 to 100'.

A satisfactory well is partly based on the actual drilling. The type of drilling employed can best be determined from contacting local drillers, who through a period of experience normally acquire a method best suited to local conditions.

Well should be of permanent water tight construction from above the permanent grade at the well to a continuous impervious stratum, or to a "safe depth", below the probable maximum drawdown. The upper end of the casing must be sealed against entrance of water.

CASING PERFORATIONS

Casing perforations are of two types:

(1) Those made after casing is in place and
(2) perforations cut in the factory.

The size and number of perforations are both important. Drilling samples should be taken, and size of perforations so chosen that about 60% of the grains will pass through the openings. As the finer materials are pumped out, the larger grains will settle around the

casing, forming an area with greater porosity and larger passages for water flow. Pumping tests will indicate the adequacy of perforations. It is essential to drive the casing into solid rock, solid clay, or some impervious stratum, and to sufficiently seat and seal the casing.

Drilled wells should be a minimum of 6" in diameter.

DUG WELLS

Dug wells may be satisfactorily constructed where conditions make it impractical to install other types.

It is necessary to use great care in construction, as dug wells are susceptible to contamination. A watertight seal must be made to eliminate entrance of surface waters. Minimum diameter should be 3' and preferably 4' to permit a person to work in well.

Well lining may be either brick, terra cotta pipe, concrete pipe, rubble or poured concrete. The lining extending into the water bearing strata shall be perforated. In the case of brick or rubble use open joints through the water bearing stratum. Joints above this stratum shall be laid with mortar.

Curbing shall be brought up to a foot above ground level. A concrete seal extending from top of curbing down the outside of curbing to the water bearing stratum should be placed.

A concrete platform or cover is then constructed over the well. Surface of cover shall slope away from pump for drainage. A manhole and cover shall be provided. Cover must be waterproof. Asphalt or mastic may be employed for sealing against entrance of water.

Figures 3, 4 and 5 show different types of well lining.

PUMPING EQUIPMENT

The capacity of pumping plants should be sufficient to pump an amount of water in 8 hours equal to the maximum daily consumption. Therefore the capacity in gallons per hour should not be less than 1/8 of the maximum daily consumption.

There are many kinds of pumps and motive power. Initial cost in selection should not be the only consideration, as it is important that the equipment also has a long economical life.

A suction pump for a shallow well cannot lift water from below the practical suction lift which is dependent upon the type of pump and the elevation above sea level. The lift will be 22' or less, as shown in the following table.

Elevation	Practical Suction Lift	
	Reciprocating Pumps	Centrifugal Pumps
Sea Level	22 feet	15 feet
1000 feet	21 feet	14 feet
2500 feet	20 feet	13 feet
4000 feet	18 feet	11 feet
5000 feet	17 feet	10 feet
6500 feet	16 feet	9 feet
8000 feet	15 feet	8 feet

WINDMILL PUMPING

Where a windmill is to be used for pumping, the following must be known or selected: size of wheel and sails, wind velocity, size of cylinder and water lift required.

CYLINDER

The cylinder size should be determined by the water requirements, depth of well, and size of wheel. Do not use too large a cylinder, as a small cylinder operating continuously will pump more water than a large one standing still part of the time.

Table I will assist in choosing the cylinder and wheel size necessary to provide the water requirement, for the particular depth of well and elevation to which water will be pumped.

It is recommended that a cylinder be used, the leathers of which can be replaced by pulling the sucker rods only. The top cap of this cylinder is the next pipe size larger than the cylinder size. This allows the valves to be withdrawn from the cylinder for repairs or leather replacements without pulling the pipe.

In setting the cylinder and determining length of stroke the coarseness of the water-bearing gravel will in a measure decide the setting. If water bearing gravel is coarse and there is little or no danger of fine material entering the well, the cylinder may be set on the long stroke and placed low in well. If water bearing material is fine and there is danger of this material entering, the stroke should be short and the cylinder set as high as possible to prevent the sand clogging the cylinder.

The sucker rod should be set so that the valves work in the upper part of the barrel first and then lowered as the barrel wears larger. This keeps that part of the barrel above the valves always the same size or larger than the portion of the barrel in which the leathers are working.

WINDMILLS

Wheel sails shall be manufactured from hard galvanized prime sheets, wooden wheels are not recommended. Motor shall be self-oiling type, with oil capacity to last at least 9 months.

Wheel and gear shafts shall be fitted with suitable high-grade roller, ball, removable plain babbitt or bronze bearings, or equal. Turn table shall be fitted with a high grade ball thrust bearing, having hardened ground steel races.

TOWER

Wooden towers are preferred, as they do not attract lightning and withstand winds in a more satisfactory manner than do steel towers. Wooden towers can also be built as a saving in cost over steel towers.

Tower shall be of sufficient height that the wheel will be entirely above surrounding trees and buildings. Platforms shall be of sufficient size and rigidity to hold a man and equipment, if repairs become necessary.

Steel towers shall be the 4-post type, ruggedly constructed with angle iron corner posts, angle iron girts, and of sufficient cross section and stiffness to withstand a wind pressure of 30 pounds per square foot of projected area of tower and windmill. Braces shall be steel rods, threaded at least on one end for take up in adjustment. A ladder shall be securely fastened to tower for safe climbing. All metal, including bolts, nuts, washers, shall be galvanized or sherardized. Sufficient guides to keep pump pole in alignment shall be standard equipment. See Figure 6.

SUCKER RODS

Wooden and hollow steel rods are recommended, sizes as follows:

Cylinder	Hollow Steel	Wooden
1-3/4" to 1-7/8"	5/8"	1-1/8"
2" - 3-1/4"	7/8"	1-3/8"
3-1/2" to 4"	1"	1-7/8"

Galvanized rods, couplings, and copper or cadmium plated rivets are recommended in order to protect against possible action of minerals in the water.

TUBING AND FITTINGS

All tubing shall be galvanized, plugged and reamed, of standard weight. Size of tubing shall be the next standard size larger than the cylinder, so that valves may be withdrawn for repair of leathers, without pulling the pipe.

Tubing must be suspended by some type of clamp. A clamp may be fabricated from 3/8" or 1/2" flat iron. A cast iron pipe holder with set screws is the most satisfactory method to hold pipe. A coupling, tee or some other fittings should be screwed to pipe just above the clamp so that fitting rests on clamp, and weight of pipe is then carried by the fitting resting on the clamp. A seal is recommended between clamp and pipe, and clamp and casing. Asphalt may be used.

A tee used above the clamp can be used for placing a hose bibb in the line, to provide drinking water and drainage of the riser during cold weather.

In locations where freezing temperatures are found, the riser pipe should be insulated from the ground to a point one foot above the hose bibb. If no hose bibb or outlet is provided the insulation must be carried to the storage tank, or if supply pipe is located below ground surface, the pipe should be buried below frost line. See Figure 7.

PUMP JACKS AND MOTORS

The need for a pump jack and motor can best be determined from installations in the vicinity.

Pump jacks shall have all gears enclosed, to insure perfect lubrication, protection from dust and dirt, and safety for persons. Stroke shall be the same as that of the windmill.

STORAGE TANKS

Tank should have a storage capacity equal to five times the daily requirement when pumping with a windmill. When a pump jack and motor is installed, this capacity may be reduced to 1-½ to 2 times the daily water requirements.

Cypress, redwood, or steel tanks may be used. Wooden tanks keep the water cooler, are not subject to corrosion. Steel tanks are subject to corrosion, heating of the water, but do have less maintenance. Wooden tanks are subject to leaks when alternately drying and wetting occurs. In general however, wooden tanks are preferred.

Tanks must be covered to prevent the entrance of rain, bugs, flies, animals.

Tank dimensions for any capacity can be found from any tank manufacturer. Manufacturers will supply prints showing proper installation. Care must be taken in installing wooden tanks, as the tank rim must not rest on the sills or joists.

In cold climates, tanks should have double roofs, and capacity must be such to allow for ice which may form as thick as 12" around the sides, reducing available tank capacity. See Figure 8 for tank cover.

TANK TOWERS

Wooden towers are recommended over steel. Heights should be a minimum of 10' and bottom of tank should be at least 8' above highest outlet in the water line. Towers should be strong enough to hold the maximum anticipated future storage requirements. Figure 9 shows a typical tower.

FOOTINGS FOR TANK TOWERS

Footings for tank towers are difficult to standardize, because of varying soil conditions. Minimum size of footing is recommended as 18" square and 15" in thickness. This will care for storage tanks up to 1000 gallons capacity and 10' towers.

The following table shows a few typical storage tank towers and the recommended minimum size of footings. Footings shall extend 9" below frost line, in addition to dimensions as shown:

Tower Height Feet	Tank Size Gals.	Width	Length	Thickness
10	1000	1'-6"	1'-6"	1'-0"
20	3000	2'-2"	2'-2"	1'-6"
30	3000	2'-6"	2'-6"	2'-0"
40	5000	3'-0"	3'-0"	2'-6"
50	10000	4'-6"	4'-6"	4'-0"

These dimensions are based on allowable earth pressure for alluvian or loam. If any doubt exists as to proper footing sizes, consult the District Engineer's office.

HYDRAULIC RAMS

There are many different types of rams, and it is important that all controlling factors be known before such equipment is purchased. The manufacturers of such equipment can furnish full details regarding the requirements, and their instructions must be closely followed to insure efficient results. A typical ram installation is shown in Figure 10, together with some useful data as to requirements.

STOCK WATERING TANKS

Tanks for watering livestock may be constructed of wood, metal or concrete. Capacity should be about 5 times the daily requirement. A cover should be provided to keep out small animals and chickens. Figure 11 shows a typical installation.

DISINFECTION OF NEW EQUIPMENT

(Taken from Engineering Handbook, Sanitary Standards for Rural Water Supplies and Systems, April, 1940.)

Whenever a new source of drinking water is developed, whether it be a spring, well, cistern, or storage tank, it must be thoroughly disinfected before being put into use. This disinfection must not be confused with the sterilization of water in connection with treatment. It is done to assure the cleansing of all new equipment and construction.

Disinfection can be done with calcium hypochlorite, better known as chlorinated lime or bleaching powder, containing 30% available chlorine, or high test hypochlorite, commonly called "H.T.H.", or Perchloren, containing approximately 65% available chlorine. A solution of approximately 50 p.p.m. (parts per million) available chlorine should be used to effect complete and proper disinfection of all interior walls of springs and wells. The interior of new cisterns and storage tanks should also be scrubbed down with a similar solution. In the case of wells, in order to have the side walls thoroughly washed down it is advisable to pump the solution back into the well.

Table 3 is given to assist in obtaining proper mixtures for disinfecting wells or other sources of supply. The solution may be mixed in a clean container of 30 to 50 gallon capacity and then siphoned or poured into the well or encasement.

TABLE 3 Chart for dosages of 50 parts per million

Capacity of well in gallons	50	100	200	300	400	500	1000
Ounces of chlorinated lime	1.3	2.6	5.2	7.8	10.4	13.0	26.0
Ounces of H.T.H. or Perchloron	0.5	1.0	2.0	3.0	4.0	5.0	10.0

One ounce = 2 level tablespoonfuls: 3 teaspoonfuls = 1 tbsp.

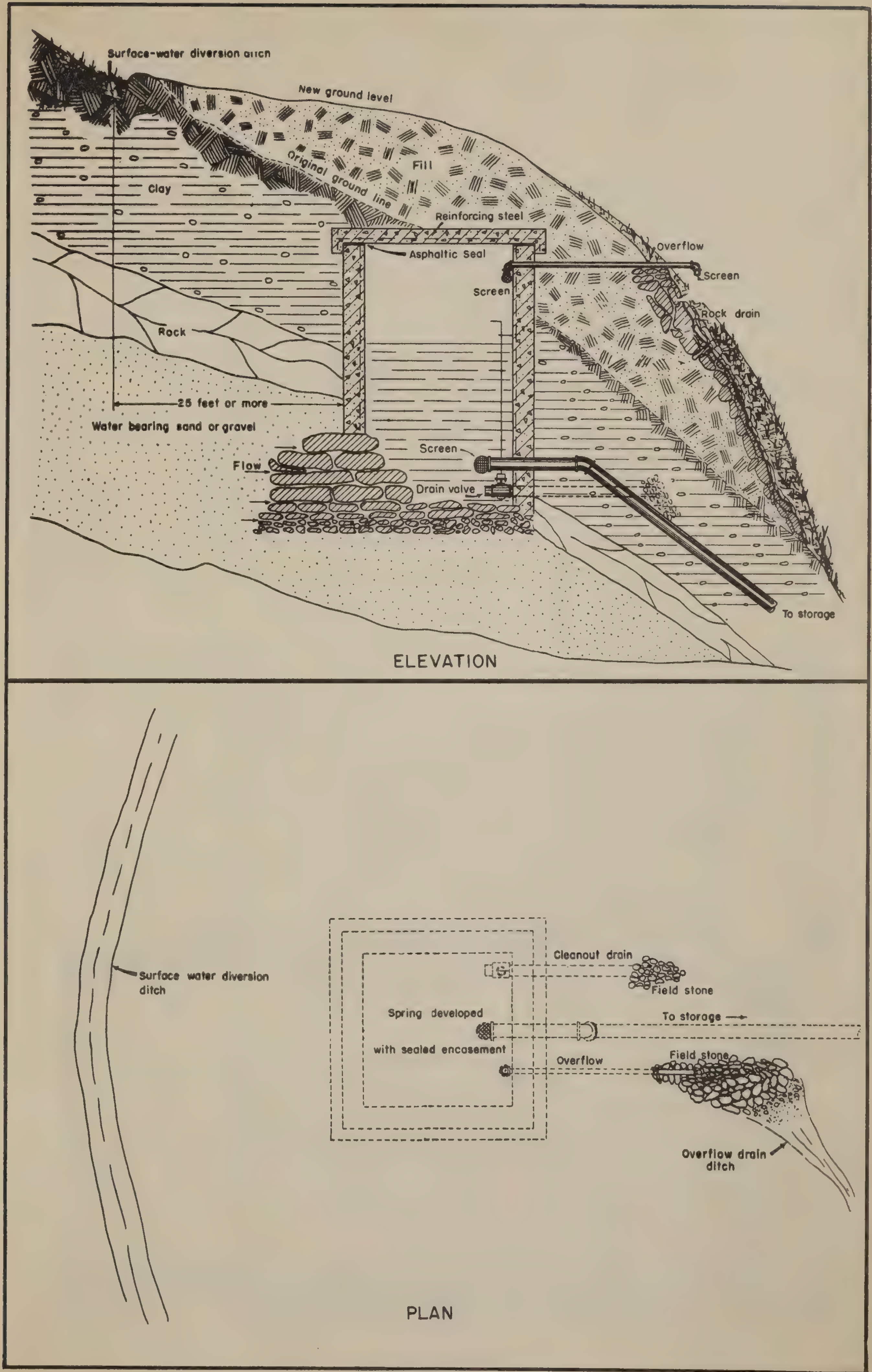
In some instances, it may be possible to effect a more complete disinfection of a drilled well by using a perforated can on a rope. The chlorinating powder can be placed in the can and the can weighed so as to reach the bottom of the well. By pulling the can back and forth through the water in the well all the powder will be finally dissolved and the water thoroughly sterilized. In every instance a slight taste and odor of chlorine should be noticable in the water immediately after disinfection.

Table 4 gives the various well and storage tank sizes to assist in computing the quantity of water to be treated under various conditions.

TABLE 4 Well and storage tank capacities in gallons.

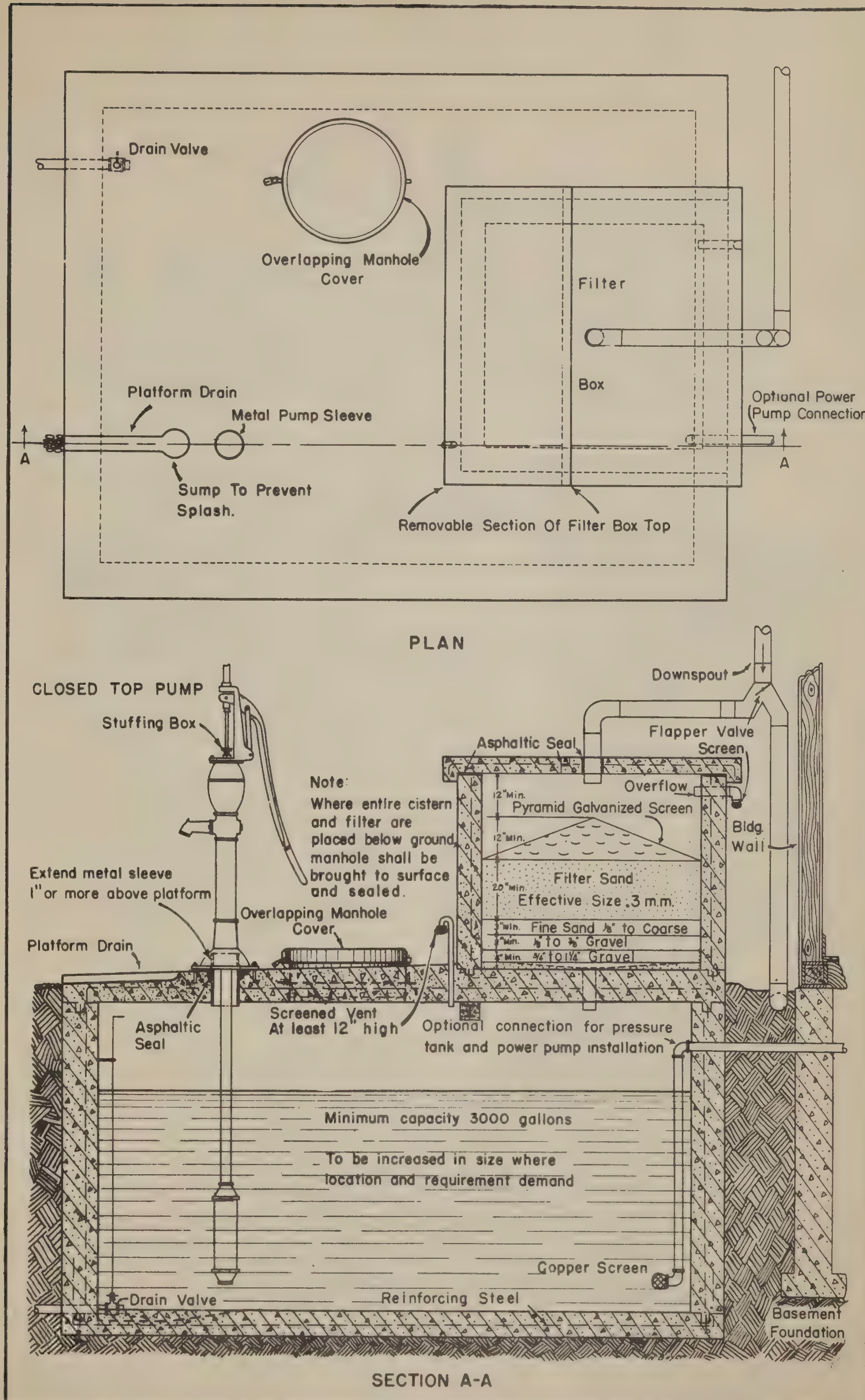
Diameter of well	2"	4"	6"	8"	10"	12"			
Gallons of water per vertical foot	.16	.6	1.5	2.6	4.1	6.0			
Diameter of storage tank	2'	3'	4'	5'	6'	7'	8'	9'	10'
Gallons of water per vertical foot	24	53	94	147	212	288	376	477	590

In order to get the total number of gallons of water in any circular well, cistern, or storage tank, take the quantity given in gallons in Table 4 for one vertical foot of the container and multiply by the total vertical feet of water.



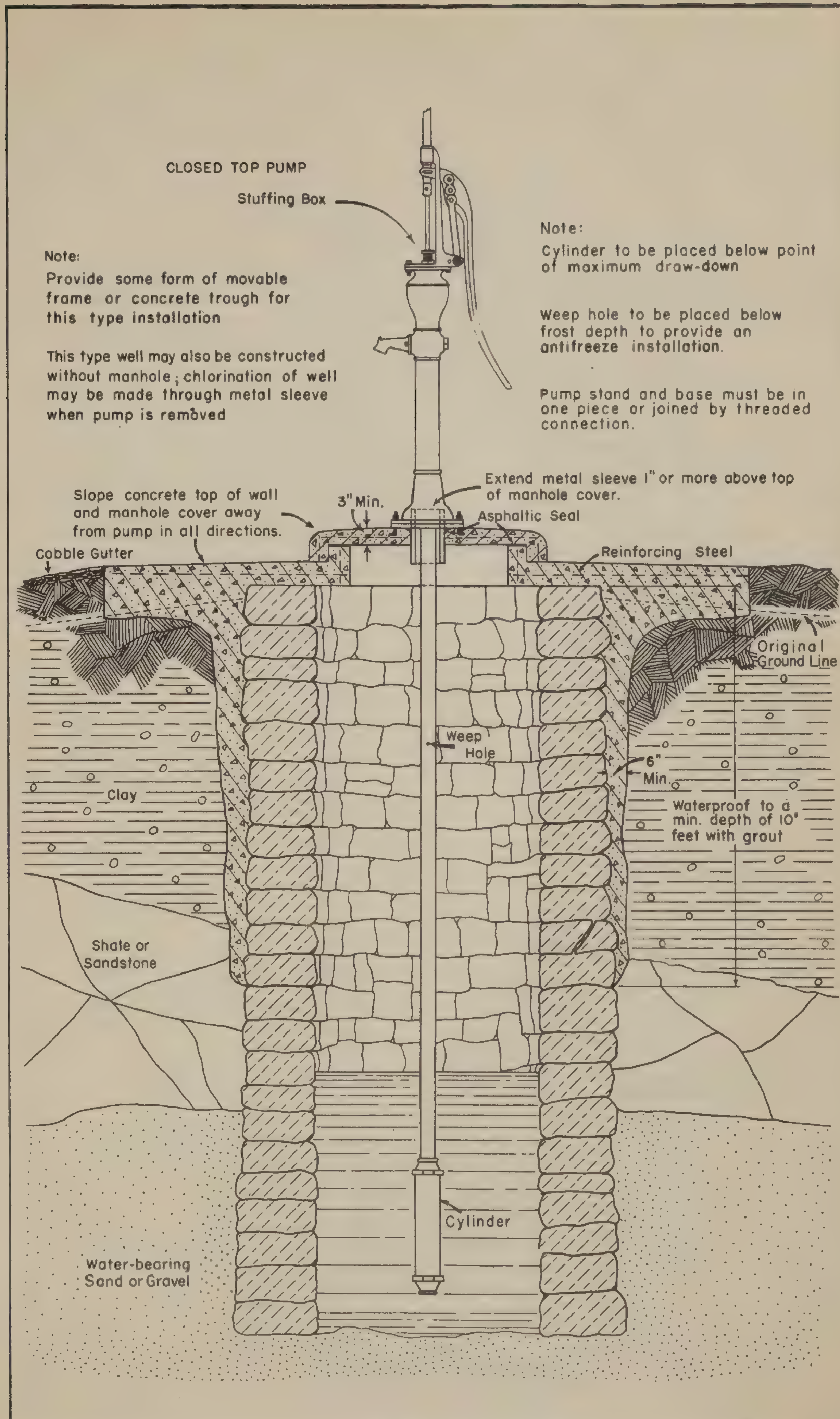
Properly developed spring.

FIG. 1



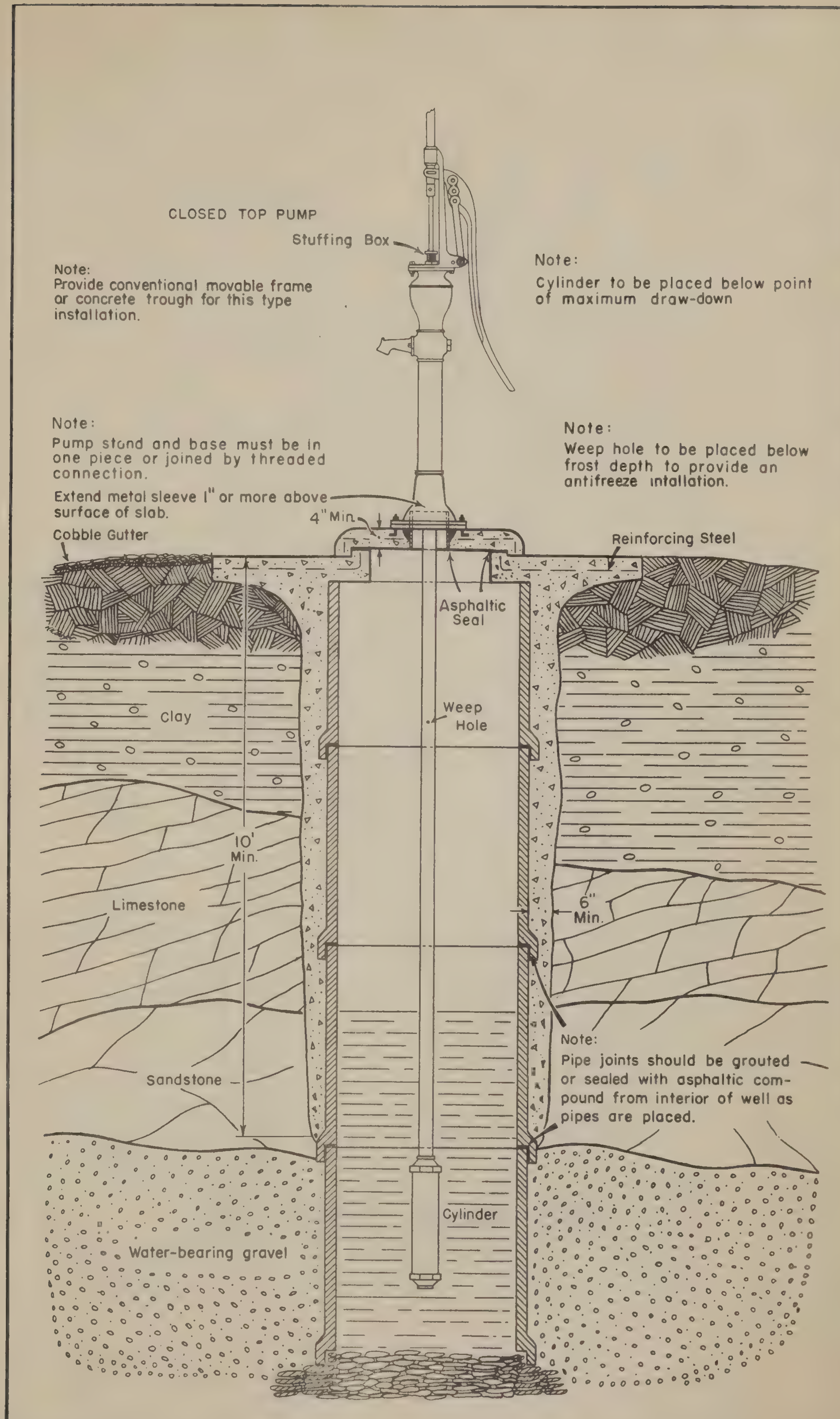
Properly designed cistern showing optional pump installations.

FIG. 2



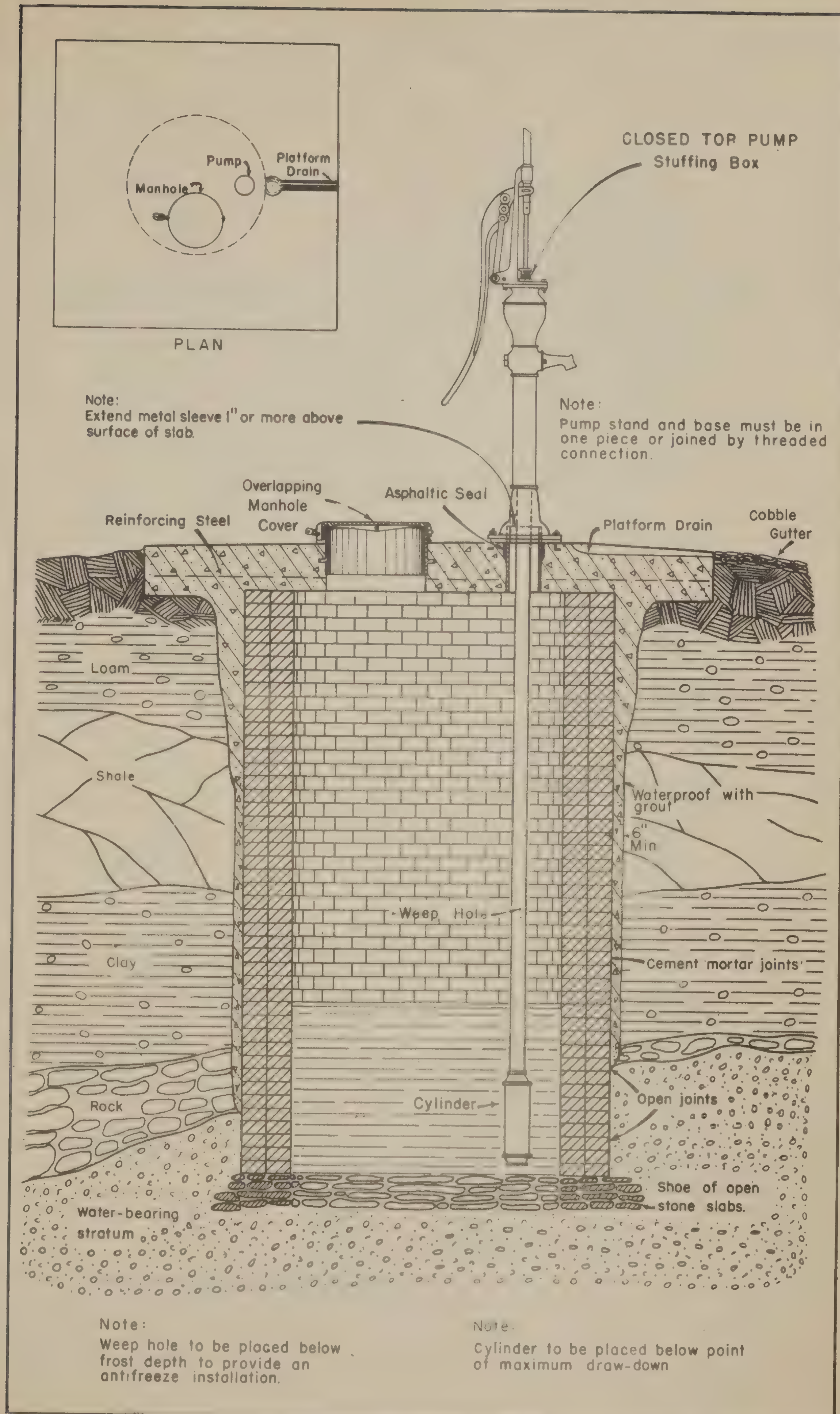
Reconstructed stone-curbed dug well.

FIG. 3



Dug well properly cased with terra cotta pipe.

FIG. 4



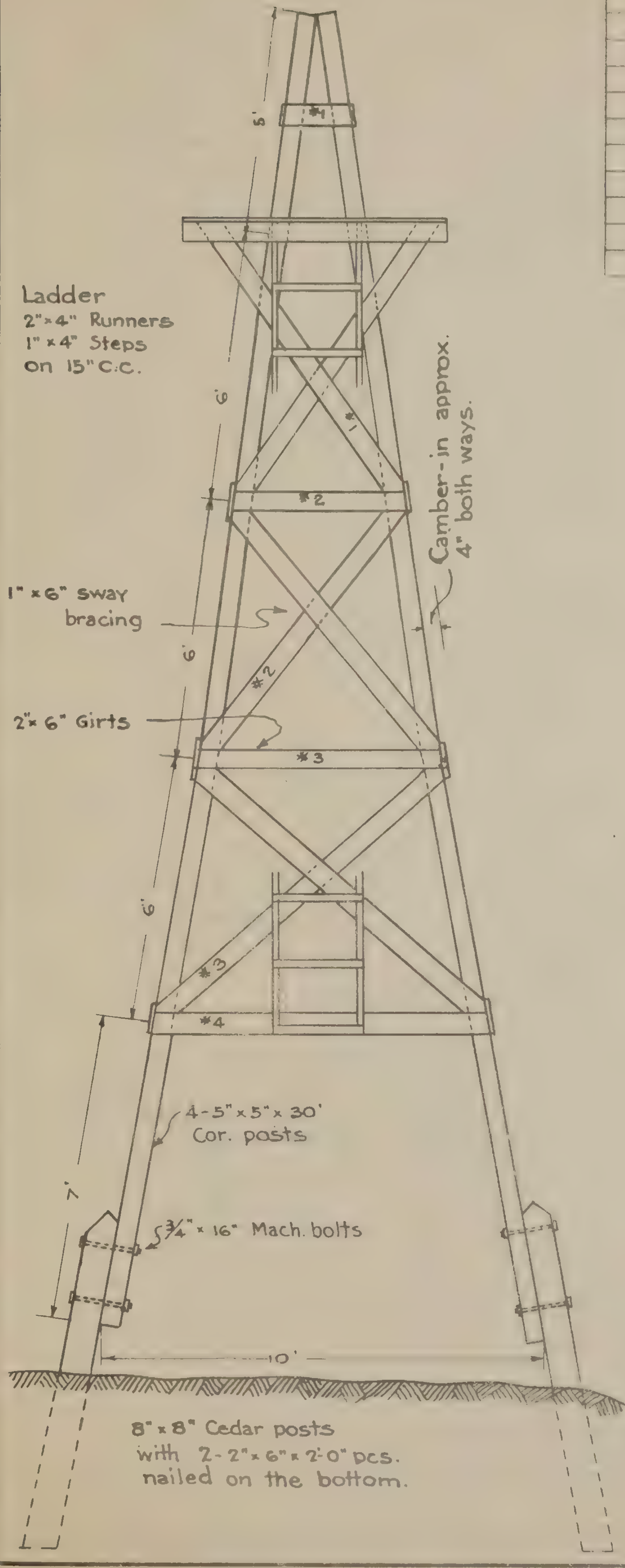
Properly constructed dug well with brick curbing.

FIG. 5

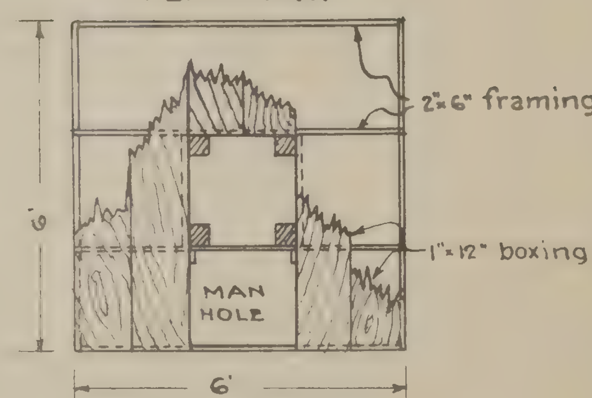
MATERIALS

	PCS.	DIMEN.	GRADE	FBM
POSTS	4	5" x 5" x 30'		250
	6	2" x 6" – 6'	#1 S4S	36
	6	1" x 12" x 6'	#2 Boxing	36
GIRTS #1	6	2" x 6" x 2'	#1 S4S	12
#2	4	2" x 6" x 4'	"	16
#3	4	2" x 6" x 6'	"	24
#4	4	2" x 6" x 8'	"	32
SWAYS #1	4	1" x 6" x 16'	#1 Rgh.	32
#2	4	1" x 6" x 16'	"	32
#3	4	1" x 6" x 18'	"	36
LADDER	2	2" x 4" x 20'	#2 S4S	27
	2	1" x 6" x 16'	#1 S4S	16
GUIDES	2	2" x 6" - 6'		12

ANCHORS 4 Cedar posts 8" top 8' long
HARDWARE 8 3/4" x 16" Mach. bolts.
NAILS 8d 3 #s Ladder
16d 8 " Sways
20d 10 " Girts & Ladder
WASHERS 3/4" Flat wr't 3 Lbs.
PAINT 3 gals. mixed, barn.



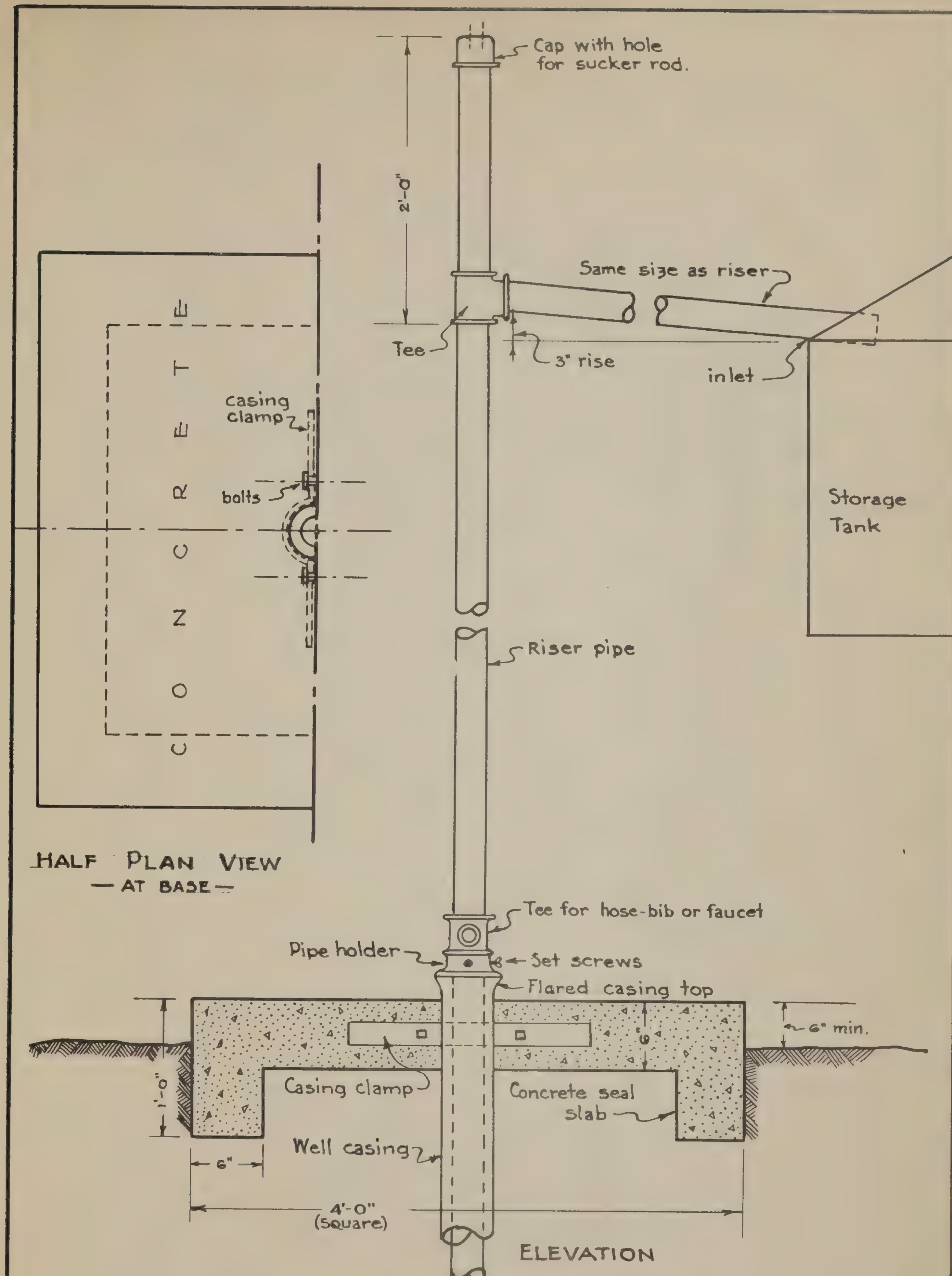
PLATFORM



30 FT. TOWER
WOOD WIND-MILL TOWER

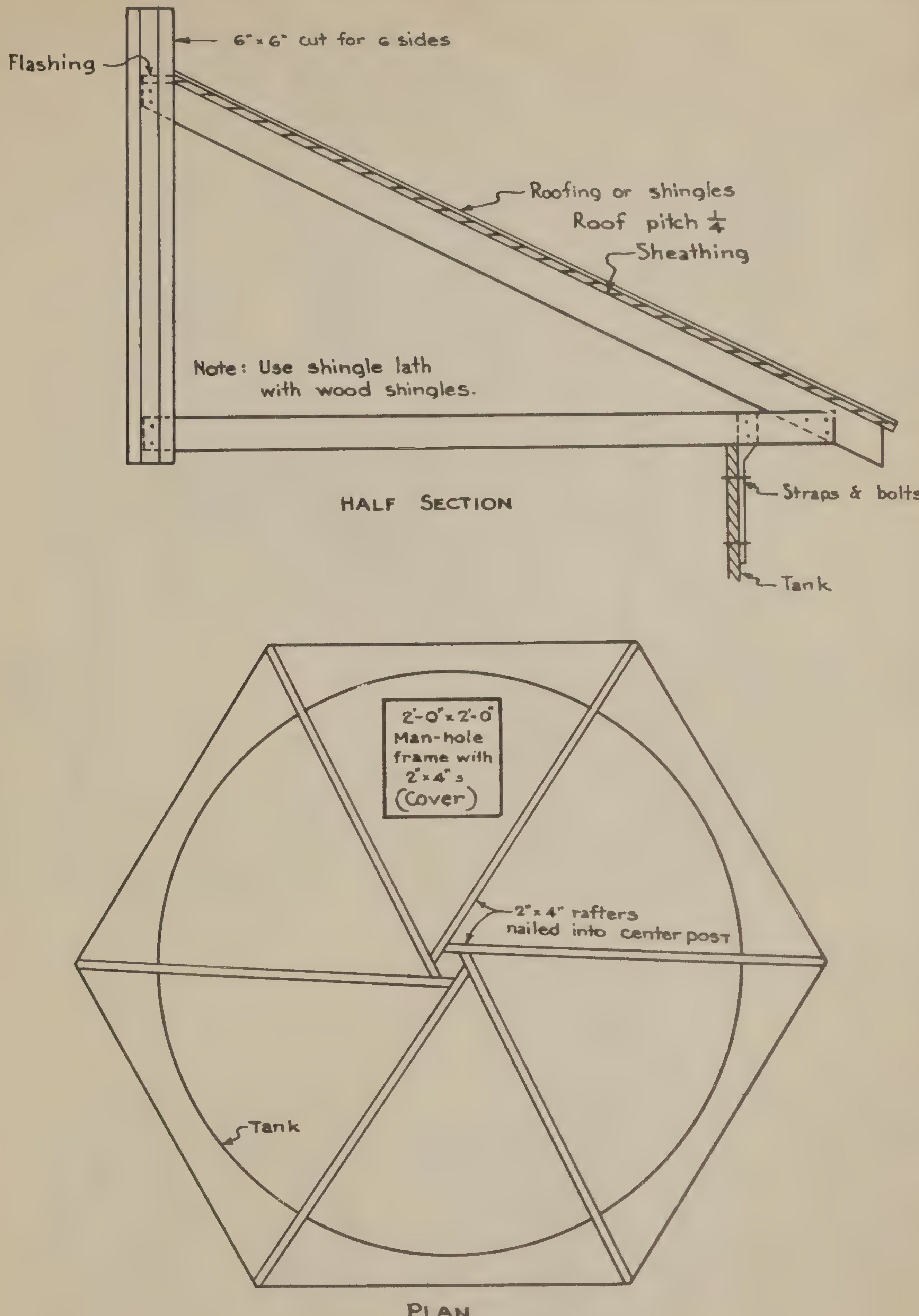
This tower is for 12 & 14 foot mill heads. For 6, 8 & 10 foot mill heads use 4" x 4" corner posts. For 16 & 18 foot mill heads use 6" x 6" corner posts.

FIG. 6



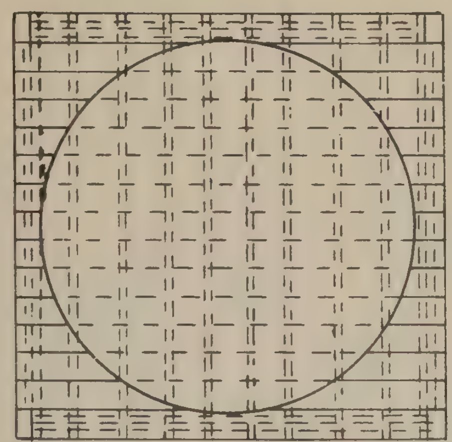
WELL CASING DETAIL FOR WINDMILL INSTALLATION

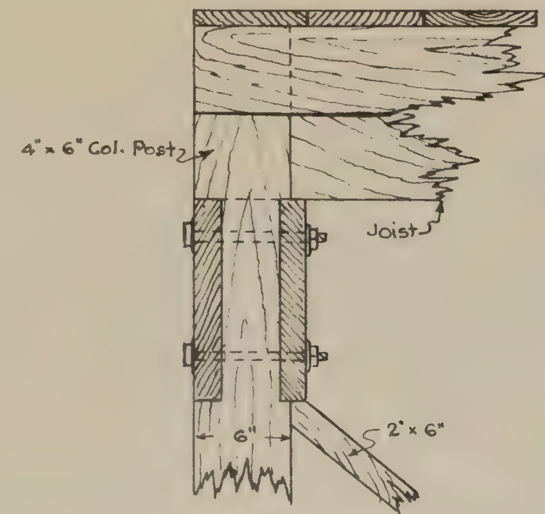
FIG. 7



SUGGESTED FABRICATED TOP
FOR WOOD STORAGE TANK

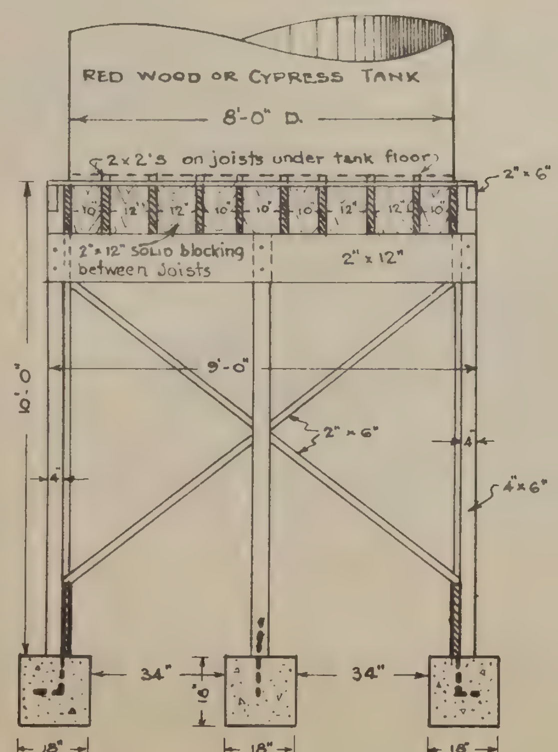
FIG. 8

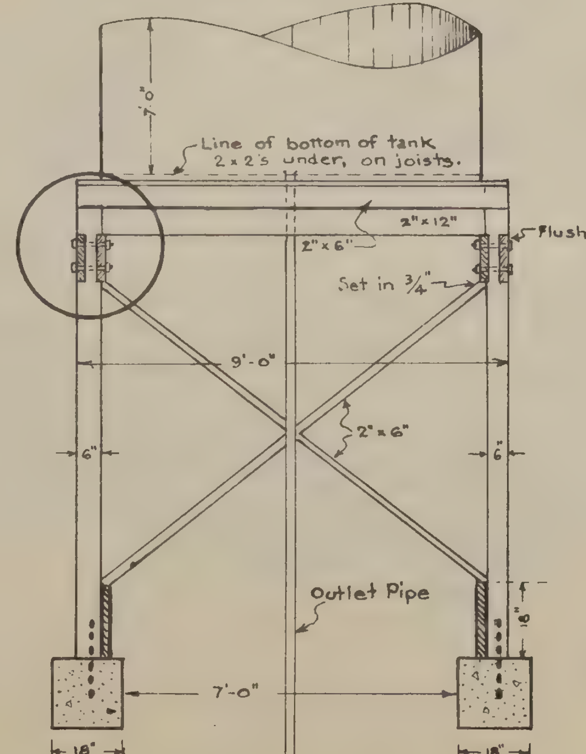




BILL OF MATERIALS				
UNIT	SIZE	F.B.M.	GRADE & MATERIALS	USE
6	4"x6"x10'	120	No. 1 S.4S. Fir or Yellow Pine	Column
8	2"x12"x18'	288	" " " " " "	Joists + Blocking
2	2"x6"x20'	40	" " " " " "	" + Blocking
4	2"x6"x20'	80	" " " " " "	Cross - Bracing
8	1"x8"x18'	96	" " " " " "	Flooring
12	5/8"x9"		Machine Bolts	Outside Girders
6	1/2"x5"		" "	Anchor Bolts
6	1/4"x2"x2'		Flat Steel	Anchors
3 lbs	5/8"		Flat Wrt. Washers	
1 lb	1/8"		" " "	
8 lb	16 D		Box Nails	Bracing + Toe Nailing
2 lb	8 D		" "	Flooring
3 1/2 gals			Paint	Covering
5 Sacks			Cement	Footing
1 Cu. Yd.			Sand + Gravel	

NOTE: 2 x 2's Under Tank Floor not included in bill of material.





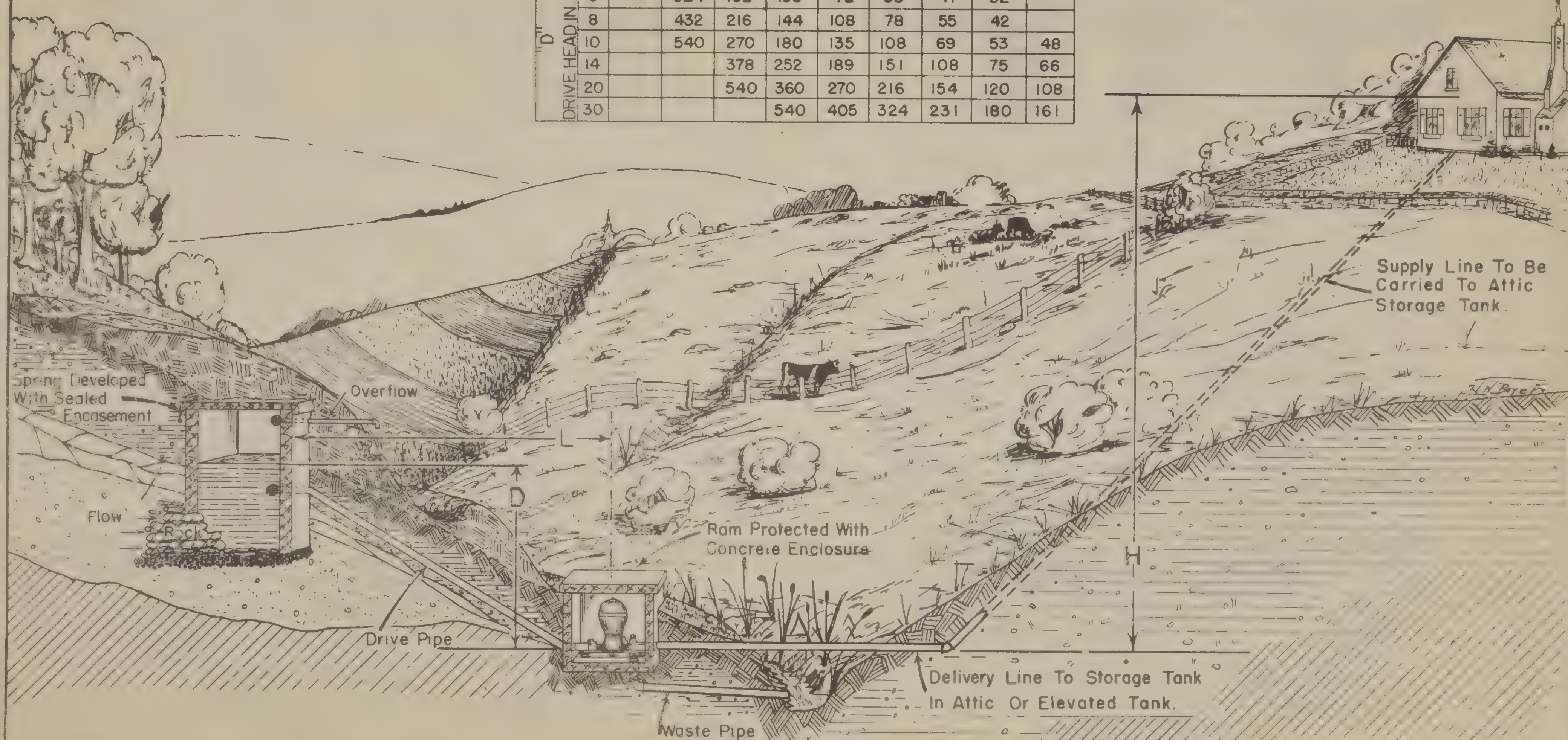
TANK TOWER
80 BBL. CAPACITY

FIG. 9

TABLE OF APPROXIMATED DELIVERY CAPACITIES

GIVING GALLONS PER 24-HR. DAY DELIVERED FOR EACH GALLON OF SPRING WATER FLOWING PER MINUTE AT VARIOUS DRIVE HEADS AND DELIVERY HEIGHTS

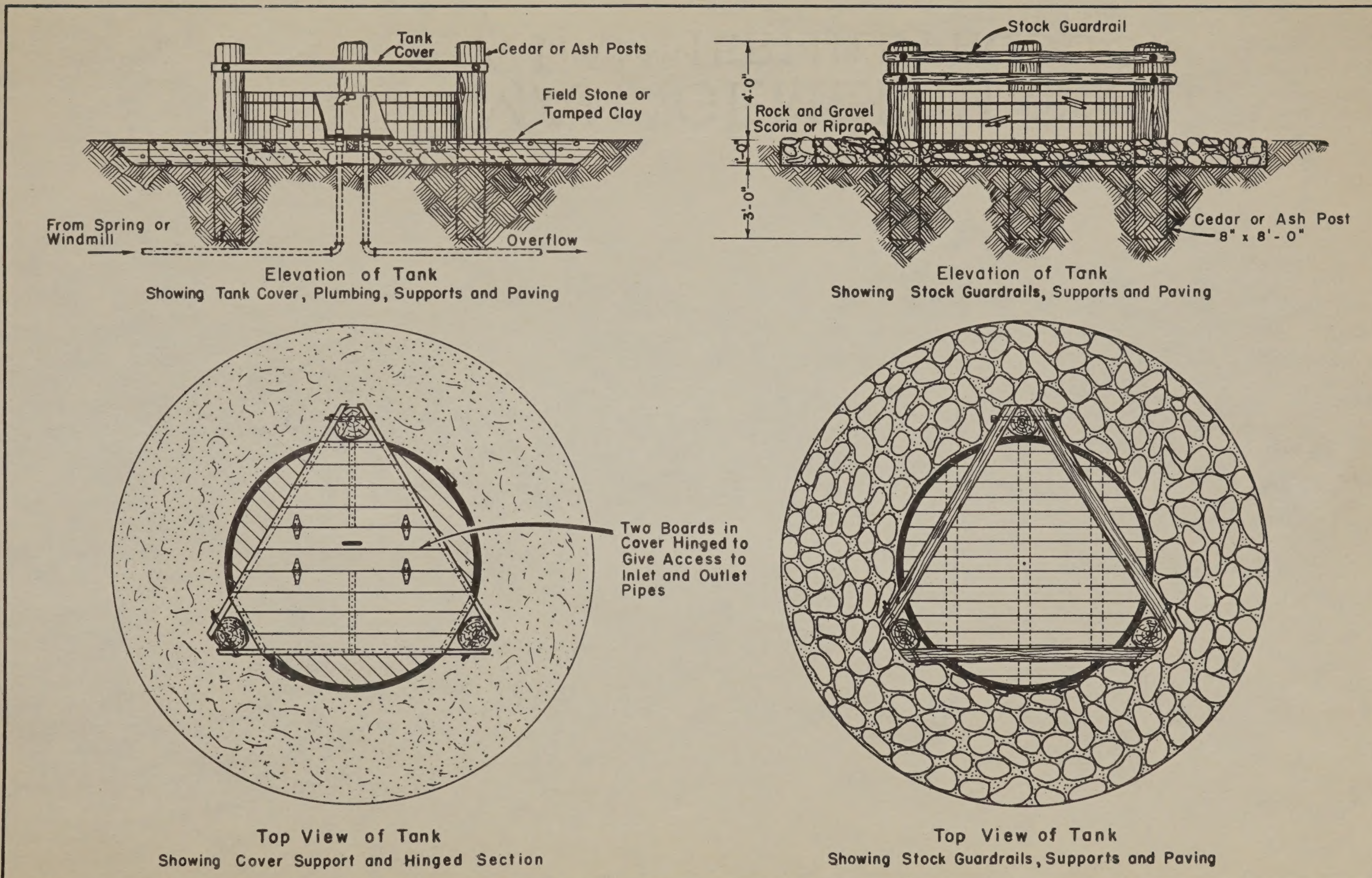
"D" DRIVE HEAD IN FEET	"H" (DELIVERY HEAD IN FEET) 10	20	40	60	80	100	140	180	200
4	432	216	108	64	48	38			
6		324	162	108	72	58	41	32	
8		432	216	144	108	78	55	42	
10		540	270	180	135	108	69	53	48
14			378	252	189	151	108	75	66
20			540	360	270	216	154	120	108
30				540	405	324	231	180	161



Note
Length Of Drive Pipe (L) Should Never Be Less Than 5, Nor More Than 10 Times The Head Of Fall (D) Under Which Ram Is Placed Regardless Of Delivery Head (H).

Proper hydraulic ram installation.

FIG. 10



Satisfactory designs for cattle watering tanks.

FIG. 11